Air Resource Management Program National Report

2010

"Consider the importance of the atmosphere, and its quality, to the health and vitality of National Forests and the resources we manage. The atmosphere interfaces directly with every resource we manage, terrestrial, aquatic, cultural, and even our visitors, who tell us their number one reason for visiting national forests is to breathe fresh, clean air and experience our vistas and spectacular scenery."
Rich Fisher, National Air Program Manager Emeritus, 2006

State of Our National Forest Air

ARM Program National Report

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INTRODUCTION: A NATIONAL OVERVIEW

Purpose of ARM Program National Report

The purpose of the Air Resource Management (ARM) Program National Report is to convey the results of the Air Program's monitoring and management efforts and to demonstrate the value added to the overall mission of the Forest Service.

Vision and Focus Areas of the Air Program

The ARM Program envisions a healthy environment of occurring natural processes for current and future generations. We believe the health of humans and ecosystems are inseparable, clean air is essential, and science is a foundation for taking action.

Understanding	Assessment	Integration
science based understanding of cause and effect	quantifying cause and effect	articulating implications of cause and effect

Who We Are

The ARM Program hosts a network of technical and policy-orientated specialists with backgrounds in biology, engineering, physics, ecology, botany, hydrology, soil science, and forestry. We are fluent in the language and concept of air emission inventories from natural and industrial sources and have longstanding working relationships with federal, state, and local air quality regulators and policy makers. We have an exemplary relationship with Forest Service Research stations and atmospheric scientists outside the agency. We are known for our ability to interpret research findings in a way meaningful to policy, regulatory input, and forest management strategies.

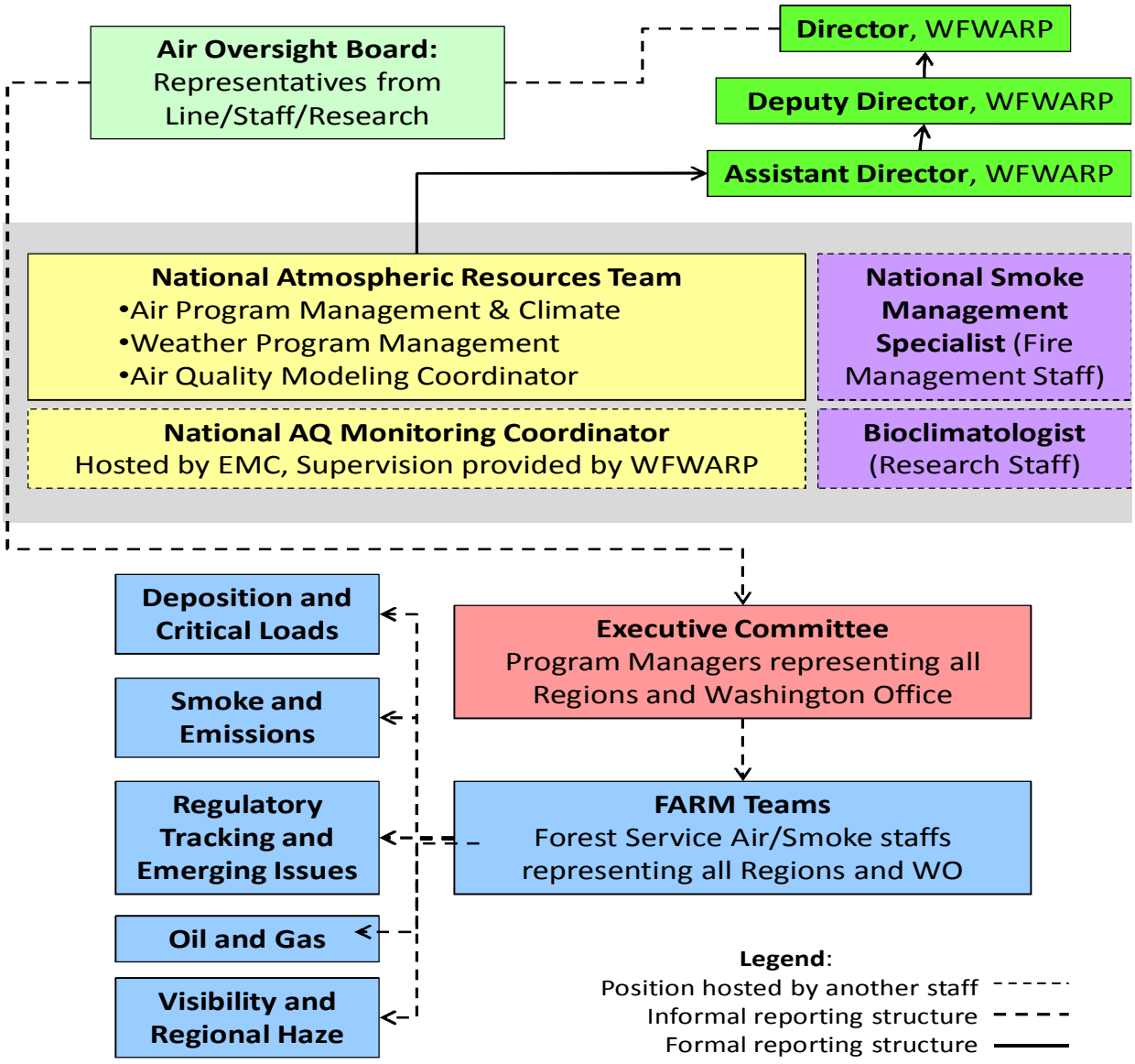
Our staffing consists of Zone Specialists (representing multiple and in a few cases individual National Forests), Regional Specialists, Regional Program Managers, and a small contingent assigned to the WO including program management, weather, modeling, and monitoring.

Responding to the challenge of a growing workload and limited staffing the Air Program has

developed a non-traditional ad hoc national organization that leverages the skills and efforts of our staff of 37. Inter-state and inter-regional transport of air pollution creates an environment that requires persistent attention to coordinated efforts. The ad hoc organization consists of:

- **Oversight Board** – This volunteer group has consisted of Regional Directors, Forest Supervisors, and Deputy Regional Foresters. The Board reviews our work plans, briefing papers, and products, giving us valuable feedback on priorities, policy, and correcting our course as necessary.
- **Executive Committee** – The Executive Committee consists of the National and Regional Program Managers and key advisors. It provides support to the National Program Manager in developing national budget work plans and decisions related to national monitoring efforts. The group's efforts serve the Regions in inter-regional and inter-state coordination.
- **Focused Air Resource Management (FARM) Teams** – This is the crucial core to the ad hoc organization. These teams are not fixed but arise from a need to address an issue on a national level. Continuation of a given team is addressed annually or sooner if necessary. Current teams include Oil and Gas, Smoke, Deposition, Regulatory Tracking, and Visibility/Regional Haze.

The Air Resource Management
"Organization"



Strengthening Our Effectiveness through Organization

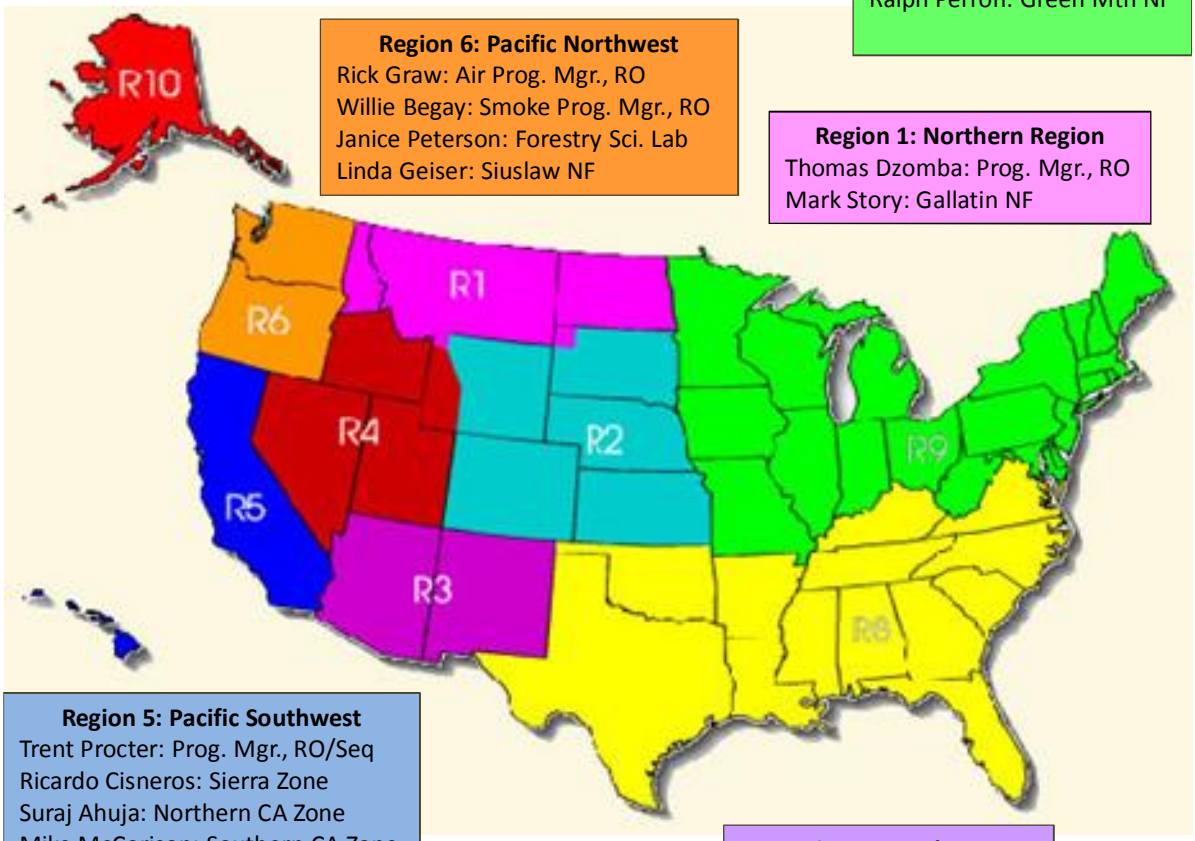
As mentioned in the section on National Organization, we have organized to effectively deal with national issues that meet the objectives of Regions and Forests through teams focused on specific topics. We also have an Executive Team that sets priorities and makes recommendations on the national budget. In addition, we have a role for an oversight team made up of Regional Directors and line officers provides recommendations on priorities that meet the needs of leadership.

*Air Program "staff" and locations throughout the country**

Washington Office
Anne Zimmermann: WFWARP Director
Chris Iverson: WFWARP Asst Director
Ann Acheson: Natl Air Program Manager
Bret Anderson: Modeler, Ft. Collins, CO
Ann Mebane: Monitor. Coord., Cody, WY
Scott Copeland: CIRA

Region 10: Alaska
John Lane: Prog. Mgr, RO
Karen Dillman: Tongass NF

Region 9: Northeast
Chuck Sams: Prog. Mgr, RO8
Tedd Huffman: Monon. NF
Trent Wickman: Superior NF
Ralph Perron: Green Mtn NF



Region 6: Pacific Northwest
Rick Graw: Air Prog. Mgr., RO
Willie Begay: Smoke Prog. Mgr., RO
Janice Peterson: Forestry Sci. Lab
Linda Geiser: Siuslaw NF

Region 1: Northern Region
Thomas Dzomba: Prog. Mgr., RO
Mark Story: Gallatin NF

Region 5: Pacific Southwest
Trent Procter: Prog. Mgr., RO/Seq
Ricardo Cisneros: Sierra Zone
Suraj Ahuja: Northern CA Zone
Mike McCorison: Southern CA Zone
Andrea Nick: Southern CA Zone
Don Schweizer: Monitoring Spec.
Sharon Grant: Monitoring Specialist

Region 3: Southwest
Jack Triepke: Prog. Mgr., RO
Susanna Ehlers: RO
Ron Sherron: NF's of AZ
Josh Hall: NF's of NM

Region 2 & 4: Rocky Mtn & Intermountain
Jeff Sorkin: Prog. Mgr., RO
Debbie Miller: RO
Terry Svalberg: Bridger-Teton NF
Ted Porwoll: Bridger-Teton NF
Andrea Holland Sears: White River NF
Kelly Palmer: San Juan NF
Jill Grenon: Student Career Employment Program

Region 8: Southeast
Chuck Sams: Prog. Mgr., RO
Cindy Huber: GW-Jeff NF
Judy Logan: Quachita NF
Bill Jackson: NF's of NC
Melanie Pitrolo: NF's of NC
Anthony Mathews: NF's of FL
Dan Stratton: NF's of FL

* Names and positions reflect 2010 organization

Statute Summary

Wilderness Act: [1]

Requires Wilderness Areas to be administered "for the use of the American people in such manner as will leave them unimpaired for future use and enjoyment as wilderness."
National Forest System Wilderness Implementing Regulations: "Wilderness Resources shall be managed to promote, perpetuate, and where necessary restore the wilderness character of the land."

National Environmental Policy Act: [2]

Establishes national environmental policy and goals to protect, maintain, and enhance the environment; requires all federal agencies to examine the environmental consequences of major proposed actions, and to conduct a decision-making process that incorporates public input.

Clean Air Act: [3]

Protects human health and welfare with national ambient air quality standards; sets a national visibility goal of no human-caused impairment which was further defined through the 1999 Regional Haze Rule[4]; and establishes the Prevention of Significant Deterioration program for review of new air pollution sources.

National Forest Management Act:[5]

"National Forests are ecosystems and their management…requires an awareness and consideration of the interrelationships among plants, animals, soil, water, air, and other environmental factors within such ecosystems."

[1] Wilderness Act: http://wilderness.nps.gov/document/WildernessAct.pdf
[2] National Environmental Policy Act: http://ceq.hss.doe.gov/nepa/regs/nepa/nepaeqia.htm
[3] Clean Air Act: http://www.fs.fed.us/emc/nfma/includes/NFMA1976.pdf
[4] 1999 Regional Haze Rule: http://www.epa.gov/ttncaaa1/t1/fr_notices/rhfedreg.pdf
[5] National Forest Management Act: http://www.fs.fed.us/emc/nfma/includes/NFMA1976.pdf

National Forests: State of Resources Sensitive to Air Pollution

Although growth in rural areas may be slower than urban areas, subdivision and land conversion continues to put more sources of air pollution closer to our National Forests.

According to the Economic Research Service, USDA, Baby Boomers make up the largest component of rural migration. As Boomers move, they not only add to the pollution pressure but they bring with them a high expectation for clean air and good visibility.

Since 1990, nationwide air quality has improved significantly for the six common air pollutants (EPA 2008). Then what is the concern? Even with the continued progress, standards continue to tighten as we learn more about the toxicity of air pollution to human health and ecosystems. Approximately 127 million people still live in counties that exceed certain ambient air quality standards.

60 National Forests do not meet the 2008 standard for ozone and 82 National Forests do not meet the most stringent proposed standard for ozone. Some area sources of pollution still lack adequate control especially for oil, gas, and grazing.

U.S. regulations mainly focus on human health although the U.S. Environmental Protection Agency (EPA) has the authority to discern different standards for public health and welfare, the regulations have remained the same. However, recently the EPA is investigating and proposing secondary standards that would be different and designed to be biologically or chemically relevant to plants, water, and other public values. In addition, EPA regulations currently address pollutants as they are emitted and reside in the atmosphere and not how much is deposited on the landscape. We are currently working with our partners in research, EPA, and the National Park Service to understand the thresholds or "critical load" of our sensitive resources or ecosystems to air pollution exposure or loading.

DID YOU KNOW?

60 National Forests did not meet the 2008 standard for ozone and 82 National Forests currently do not meet the most stringent proposed standard for ozone.

With the exception of visibility, air pollution effects on forest resources are often a subtle but a critical initial stress to ecosystems. Pollutants can weaken or change living organisms, water, and soil in ways that pre-dispose them to insect, disease, drought stress, or chemical changes which can ultimately alter the structure and function of ecosystems and impact our visitor's health and experiences.

The challenge of a changing climate is likely to have a dynamic compounding effect as changing precipitation and temperature alters pollutants, specifically their toxicity

and exposure patterns. In turn, changes in air chemistry may have unknown climatic affects. Our work to reduce emissions and restore ecosystem function can add to climate change resiliency.

What are the Risks?

Ozone impacts to vegetation are a good example of ecosystem complexity. The effects of ozone range from visible injury to the leaves and needles of deciduous trees and conifers to premature leaf loss, reduced photosynthesis, and reduced growth in sensitive plant species. Other factors, such as soil moisture, presence of other air pollutants, insects or diseases, genetics, or topographical locations can lessen or magnify the extent of ozone injury. For example, higher ozone exposure levels occur at higher elevations so high elevation vegetation is at increased risk.

Mercury deposition and resulting unsafe mercury levels in fish are a national public health concern. Fish consumption advisories exist in 46 states, affecting 31 National Forests, Grasslands, and Recreation Areas. While many natural sources exist, atmospheric deposition of anthropogenic mercury, principally from coal combustion, is the major source. Because mercury is fairly stable, upland areas can accumulate large burdens from decades of deposition. Fire volatilizes stored mercury, and fire-induced soil erosion washes what's left into wetland or lake ecosystems. There it is eventually converted to the most toxic form, methyl mercury, and incorporated into fish tissue.

Nitrogen deposition can cause ecosystem impacts by unnaturally fertilizing land and water, In addition to contributing to acidic rain. These excess inputs of nitrogen, termed nutrient enrichment, can disrupt the natural flora and fauna by allowing certain species, including invasive species, to outcompete those that naturally thrive in pristine, nitrogen-limited systems. The end result is an unnatural shift in species composition for sensitive species, which may have a subsequent impact on other components of the ecosystem.

Sulfur deposition causes lake and stream acidification, altered soil chemistry and nutrient cycling, mobilization of aluminum in soil, and altered growth of spruce-fir forests. Chronic acid deposition in the east has accelerated the loss of essential nutrients in spruce-fir forests like Otter Creek Wilderness and Dolly Sods Wilderness of the Southern Appalachians. Episodic deposition in western forests has been linked to nitrogen saturation of high elevation watersheds and eutrophication of surface waters.

Visibility impairment, to some degree, likely occurs on most National Forests. The visual range within the eastern U.S. is often just 15 to 30 miles, estimated at one-third of what it would be without human caused air pollution. In the West, the visual range averages between 90 and 130 miles, or about seventy percent of the visual range under natural conditions. Visibility is a value known to affect real estate values, scenic quality, visitor experience, and

tourism. This in turn can have a significant effect on communities being able to draw tourism, commerce and related jobs.

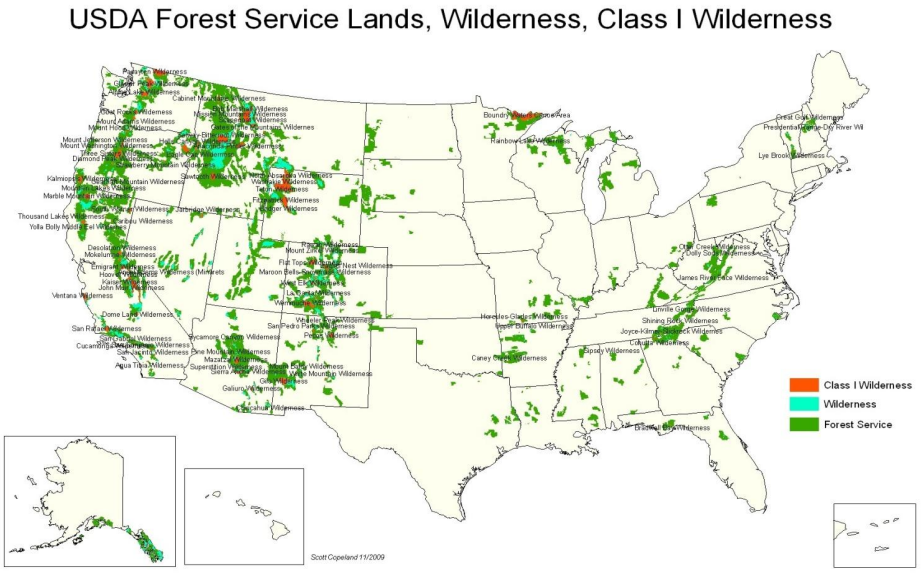
Haze is caused by fine particles in the air that scatter and absorb light. When the number of fine particles increases, more light is absorbed and scattered, resulting in a shorter visual range, less clarity and altered color. Five types of fine particles contribute to haze: sulfates, nitrates, organic carbon, elemental carbon, and crustal (soil) material.

Plume blight occurs when a point source such as a smoke stack emits particulate matter or nitrogen dioxide into a stable atmosphere. These pollutants can form a thin, dark, coherent plume obscuring the view. Both contrast and coloration may vary depending upon the plume constituents, the viewing background, the viewer angle, and the angle of the sun.

Water quality, especially water chemistry, is important in assessing the effects of air pollution on aquatic ecosystems. The assessment requires an understanding of the processes that control the chemistry and biology of each lake or stream. Aquatic monitoring often begins with a survey of surface waters to identify particularly sensitive ecosystems. Water chemistry is generally monitored directly as it will show changes more quickly than plant and animal communities. Many studies combine the monitoring of water quality with biological monitoring of diatom cores, plankton, aquatic insects, amphibians, and fish. Concentrations for the following constituents are typically assessed: conductivity, calcium, magnesium, sodium, potassium, ammonia, fluoride, chloride, nitrate, sulfate, phosphate, and acid neutralizing capacity. Acidity, as pH, is also normally evaluated.

Keeping Our "Clean Air Areas" Clean

Equally important to defining high risk areas of air pollution exposure and impact is assessing the National Forests and Wilderness Areas where the air is pristine and considered natural. These areas serve as sentinels of change. Monitoring and documenting locations where air quality is pristine enough to be considered natural allows detection of subtle change. This information helps us understand conditions that might be applicable in setting targets for other areas. In order to better assess change in areas already impacted by air pollution, we monitor pristine areas to help establish baseline or natural conditions.



The Prevention of Significant Deterioration (PSD) permit review and recommendation responsibility of the Forest Service is centered on the 1977 Clean Air Act Amendments. These amendments established goal of protecting some public lands (Class I Wilderness Areas and National Parks already established August 7, 1977) from human-caused effects of air pollution.

The Forest Service manages 88 of these Class I areas, more than any other agency. An alphabetical listing is available online[6]. The PSD review process of the Clean Air Act mandates the review by Forest Service and other Class I managers of certain new sources of air pollution. The purpose of the PSD process includes the protection and enhancement of air quality in national wilderness areas and other locations of scenic, recreational, historic, or natural value. Before the construction of certain new air pollution sources is approved, the applicants must receive a PSD permit from the appropriate air regulatory agency.

The Forest Service manager must make three decisions: What are the sensitive air pollution receptors within the wilderness that need protection? What is the critical load for these receptors? Will the proposed facility cause or contribute to pollutant concentrations or atmospheric deposition within the wilderness that will cause the critical load to be exceeded?

The first two decisions are land management issues based upon the management goals for the wilderness in

[6] Class I area alphabetical listing: http://www.fs.fed.us/air/technical/class_1/alpha.php/

question. The third is a technical question evaluated by modeling proposed emissions, background levels of pollutants and the sensitivity of visibility and forest resources to the pollutants.

Close coordination between the Forest Service and the appropriate air regulatory agency is essential in the PSD process. The Forest Service makes a determination of whether a proposed project will adversely impact Forest lands. The air regulatory agency then makes a decision to grant or deny the permit.

The Forest Service reviews the air permit applications for new and modified industrial facilities to ensure that their air emissions will not adversely impact the air quality related values (such as visibility) of federally-protected wilderness areas. The FS provides these comments to the permitting authority which, depending on delegated authority can be EPA, States, or Tribes, or Air Pollution Control Districts.

One key part of the air permit application, required by various regulations, is a review of the air pollution control technology proposed on each of the new or modified emission units at the facility. The review analyzes what types of control technologies are possible for each regulated pollutant from each emission unit at the facility. The best performing option is typically required by the air regulatory authority unless it is deemed to be too expensive for the facility or causes other adverse environmental impacts.

Our review of the best available control technology and subsequent recommendation to the air regulatory authority helps minimize air pollution impacts to the National Forests and Grasslands.

What Are We Doing about Air Quality on National Forests?

Protecting the resource & regulatory compliance

We Effectively Leverage Partnerships

The Air Program depends on partnerships to accomplish much of our work. Because our role is primarily advisory to decision makers, negotiation and communication skills are integral to our success. Air quality improvement is accomplished by many public and private groups. Our ability to influence the outcome relies on becoming a visible and active player in partnerships. We have forged a strong relationship with Forest Service Research that leverages scientific expertise from researchers with the Air Program's interest and ability to turn science into value added management strategies and policy.

Benefits for Partners

Air Program partnerships reap many rewards. Our work addresses the Chief's four pillars: Restore and enhance landscapes, protect and improve water resources, develop climate change resiliency, and create jobs that will sustain communities. We help Fire Staff monitor smoke impacts and ensure air quality standards and regulations are met. We ensure that air pollution impacts on ecosystems, including changes in biodiversity and community composition, are understood and addressed. Our partnerships with Recreation include the 10-Year Wilderness Strategy and understanding visitors' value of clean, fresh air and scenic vistas. We advocate for the lands managed by the FS through partnerships.

Smoke Management – Where Partnership and Regulatory Compliance Meet

The Air Program strives to be engaged in the regulatory environment in a way that advocates clean air and minimizes impacts while protecting the agency ability to maintain a full range of tools, including the use of fire, in treating fuels. We serve as the liaison to air regulatory agencies and work to develop positive working relationships by building trust through the application of monitoring, modeling, and science applied to minimizing impacts and public exposure.

The legal foundation of smoke management can be considered the Clean Air Act and NEPA. The Clean Air Act establishes primary (public health) and secondary (welfare and environmental quality) standards for controlling air pollution and NEPA requires we disclose the potential effects of our proposed actions. The Clean Air Act also requires the EPA to set National Ambient Air Quality Standards (NAAQS) to control pollution and protect public health, safety, and welfare. The Clean Air Act establishes state-level responsibilities for preventing and controlling air pollution.

Many of the specific requirements for smoke management are therefore found in State (or Tribal) Implementation Plans (SIPs/TIPS) and Smoke Management Programs (SMP). In addition to specific SIPs/TIPs and SMPs, fire managers should

be familiar with EPA's Interim Air Quality Policy on Wildland and Prescribed Fire.

Emissions from wildland fires are subject to the laws, regulations, and policies at state and national levels because of the types of pollutants contained in smoke. The major components of smoke are water vapor and carbon dioxide. However, smoke also contains the pollutants carbon monoxide, nitrogen oxide, hydrocarbons, and particulate matter. Because of its very small size (similar to pollen), fine particulate matter can easily penetrate deep into lung tissue, causing severe respiratory and cardio-vascular disease. This pollutant can also significantly reduce visibility on highways by scattering and absorbing light, resulting in unsafe driving conditions.

Therefore, particulate matter is the pollutant of primary concern for smoke management. Fire managers must understand how particulate matter affects public health, reduces visibility on highways and near airports, and impacts scenic vistas within Class I areas such as Wilderness Areas, National Parks, and wildlife refuges. The Air Program Smoke FARM team has developed NEPA guidance for smoke[7].

[7] NEPA guidance for smoke: http://www.nifc.gov/smoke/nepa/index.htm

Examples of Activities and Primary Partners

Activity	Partners
PSD Permit Review	National Park Service U.S. Fish and Wildlife Service U.S. Environmental Protection Agency States and Local Air Regulatory Agencies Department of Justice Industries
Smoke Management and Regulatory Review	National Park Service U.S. Fish and Wildlife Service U.S. Bureau of Land Management U.S. Environmental Protection Agency States and Local Air Regulatory Agencies U.S. Forest Service Fire U.S. Forest Service Research
Climate Change	U.S. Forest Service Research Academic Research Natural Resource Conservation Service
Visibility Monitoring	Interagency Monitoring of Protected Visual Environments (IMPROVE) U.S. Environmental Protection Agency States Agencies Tribal Governments
Ozone Monitoring	U.S. Forest Service Research U.S. Forest Service Inventory and Analysis U.S. Forest Health Monitoring
Water Quality Deposition Monitoring	U.S. Geological Survey National Park Service U.S. Forest Service Research

BEHIND THE SCENES

The meaningful accomplishments of the Air Resource Management Program require a major behind the scenes effort to acquire and assess credible information for our recommendations, decisions, and actions. Commitment to meticulous monitoring and data management followed by careful data analysis and reporting are critical to our program. Because monitoring, database management, and data analysis must be continuous to be effective, substantial investment is required in these areas.

How Do We Measure Progress?

The Forest Service monitoring efforts are focused on tracking the condition of resources sensitive to air pollution rather than the condition of ambient air. Although measurements of the resource are the "bottom line" metric, it is hard to draw conclusions without an ability to make comparisons to ambient air. Agency operated ambient monitoring that meets EPA standards is minimal. However, we are increasing the use of approved monitoring and sampling in partnership with FS Research. This allows us to better assess the relationship between ambient air and resource condition.

Monitoring and Data Collection

Types of monitoring done for the assessment of air quality and air pollution effects include:

- Smoke
- Bulk deposition: snow, precipitation, and canopy throughfall chemistry
- Atmospheric pollutants: ozone, nitrogen oxides, sulfur dioxide, and ammonia
- Surface water chemistry for acid deposition and eutrophication
- Soil chemistry
- Lichen: communities and elemental analysis
- Vegetation: foliar analyses, physiological measurements, growth, responses to ozone, acidity, and nutrient deposition
- Lake sediment monitoring
- Cultural resources: camera monitoring of rock paintings and other cultural artifacts
- Aquatic monitoring for communities and bioaccumulation of air toxins: diatoms, zooplankton, macroinvertebrates, and fish
- Technical support for national network data collections including IMPROVE and NADP
- Photography to determine visibility conditions

Commitment to monitoring is critical to detecting and providing evidence for trends— they allow us to evaluate whether management actions are leading to improvements or if conditions are deteriorating. Without our monitoring and resource staff it would not be possible to evaluate and respond to changing conditions.

Data Management

The ARM Program has different databases managed and maintained at the local,

regional, and national levels. Most data is stored in databases for long term monitoring, but some of the information is used in real-time for on-going smoke management.

NRM version 2 is our new web based master national database. This year we worked with NRM partners to complete the surface water quality data module. We developed protocols for collecting and processing lake and stream chemistry data, including QA/QC procedures. We also worked with laboratories to develop data formats that can be pushed directly into NRM, and to generally upgrade, automate and standardize our surface water data collection and storage. Our water chemistry data are provided to the public and collaborators through an interagency website. Next steps in the database development are a module for tracking PSD and NEPA permitting. This database structure will be adapted next to other types of air quality data. The NRM Air database will also offer us a way to rapidly share and query air quality and other natural resource data both in and linked to NRM for land managers at district, forest, regional and national levels.

In summary, our databases facilitate our interactions with fire managers, ecologists, air policy regulators, hydrologists, and other resource specialists. They allow us to quickly extract and digest information at appropriate levels - from a small forest-level meeting to national assessments. These databases allow us to integrate air resource management perspectives into forest planning, decision making and management activities. Our databases are continuously evolving and have required committed long-term investments to achieve the sophisticated, integrated system we enjoy today.

The Air Program work draws from other databases operated within the agency at forest and regional levels as well as national networks. These local and/or national databases include information for smoke data, vegetation monitoring, lichen monitoring, aquatic communities and fish monitoring, lake sediment data, and on-site deposition monitoring. Some of this information is also currently leveraged by our resource managers and partners to make informed decisions. Eventually, this data will be incorporated or linked into NRM. Additionally, NRM Air pulls data interactively from USGS and EPA databases, streamlining data storage needs and maintenance while making sure we have the most up-to-date data.

National networks we contribute to include IMPROVE, NADP, and FIA. Database management will continue to require baseline funding.

Air Resources Assessments

The Air Program extracts and processes monitoring information from the numerous databases into scientific publications, forest level planning, environmental assessments, regional and national documents, and

contributions to new and leading science aiding management decisions.

We work with resource specialists at the district and forest levels as well as scientists from research, academic institutions, and other federal agencies to utilize our own data and data from other efforts to produce scientifically credible reports.

CONTRIBUTIONS AND CHALLENGES

Anticipated or developing challenges

- How to engage Oil and Gas to help fund Air Quality monitoring.
- How to evaluate the direct effects from small sources of ozone.
- How to facilitate agreements with States that can allow collaboration on monitoring, research, and improving communication.
- How to be more strategic in defining our smoke monitoring role.
- How to consider asbestos and other toxics in burning and other forest management activities.
- How to emphasize developing strategies for defining critical loads and having line officers participate in developing target loads.
- How to incorporate energy efficiency into the PSD permit review process.
- How to quantify and articulate offsets between criteria pollutants and greenhouse gas emissions.
- How to define an approach to understand and reduce winter time nitrate in eastern Oregon and Washington.

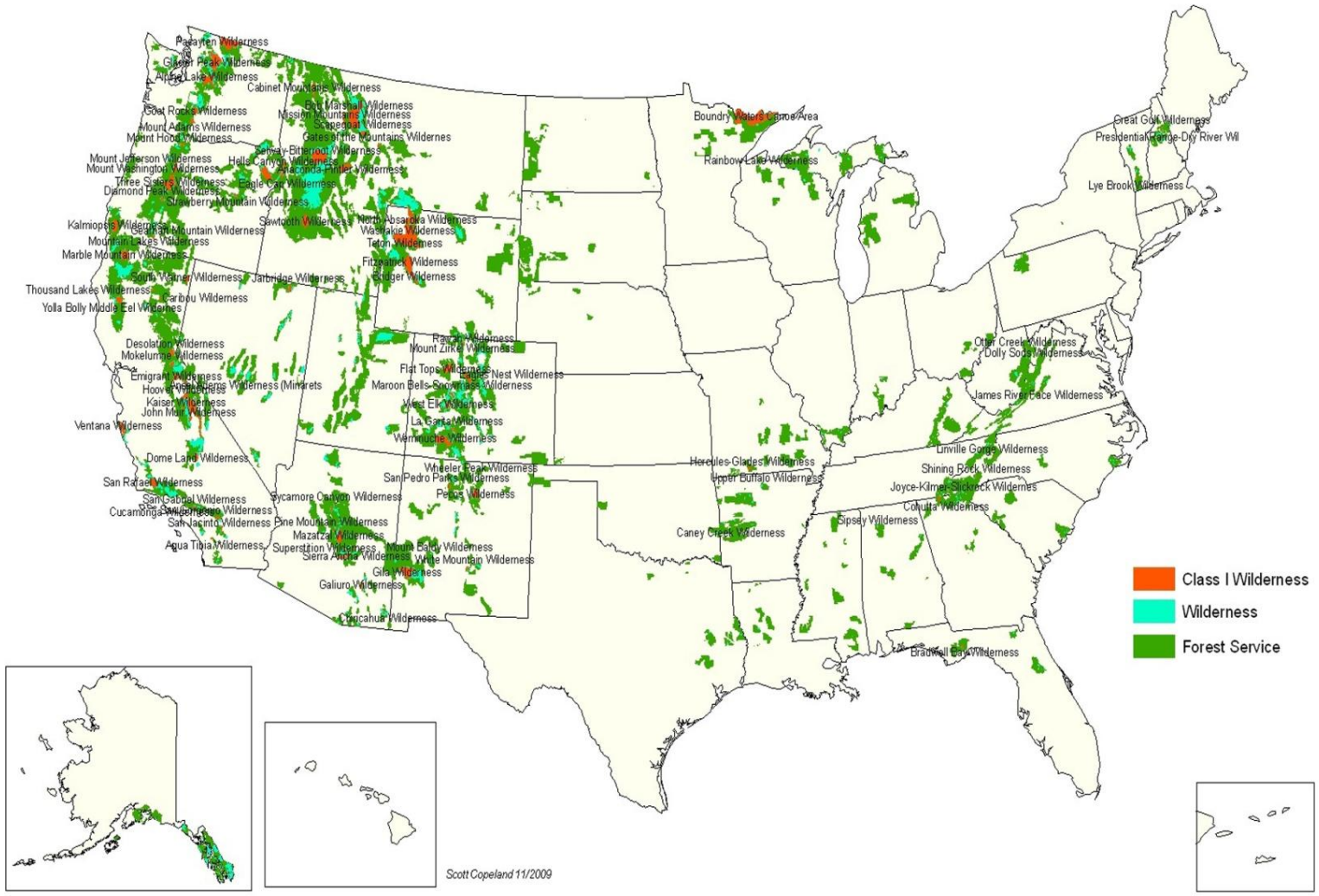
What Difference Has It Made?

Smoke management activities have allowed us to conduct more prescribed burning to restore fire as a natural part of the ecosystem.

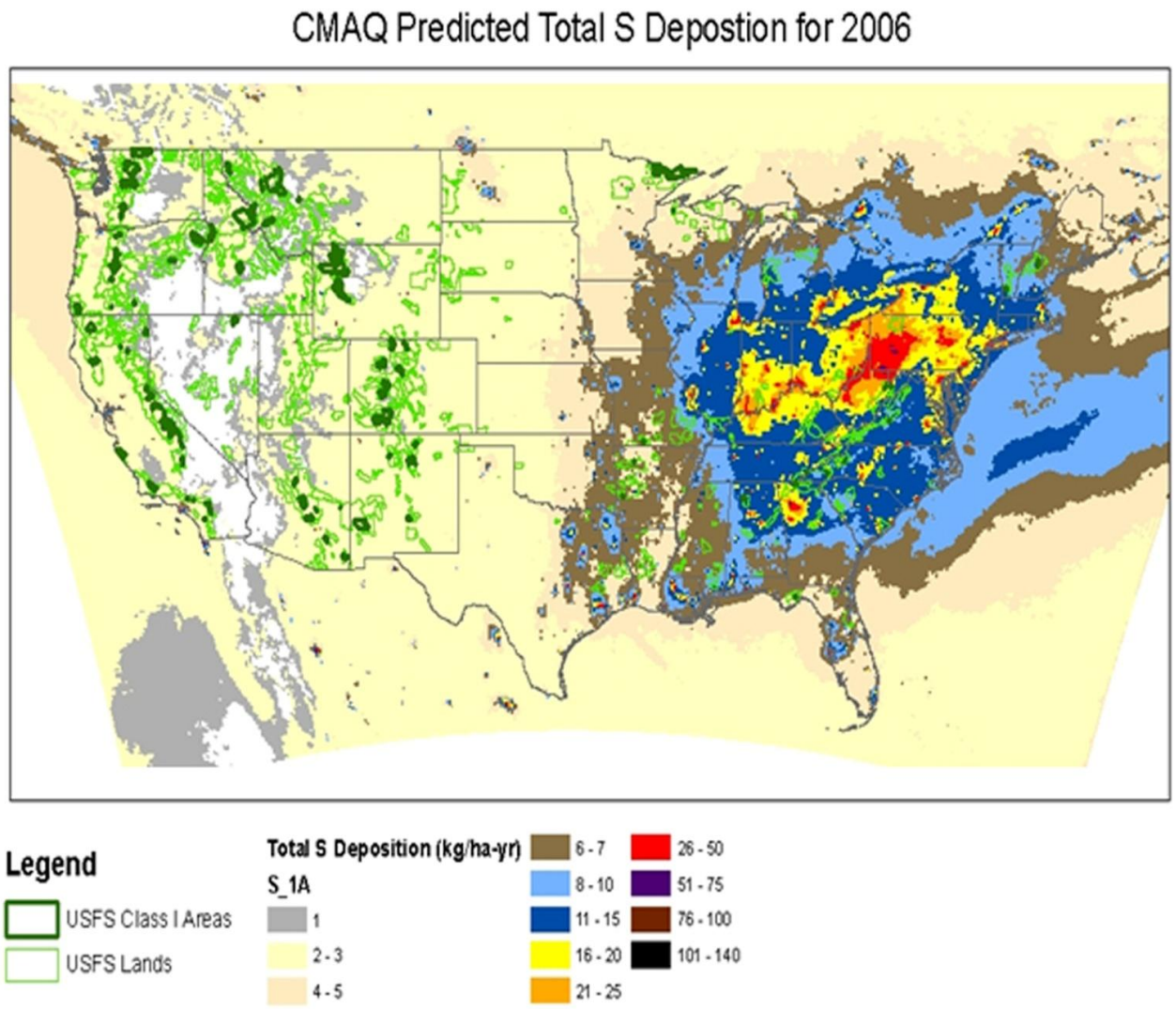
Because of our engagement in this business for 20-30 years, our efforts have resulted in healthier fish, water, and ecosystems (including forests and grasslands). All of which contributes to the Forest Service to "sustain the health, diversity, and productivity of the Nation's forests and grasslands to meet the needs of present and future generations."

UNDERSTANDING THE CONDITIONS AND TRENDS THROUGH MAPS

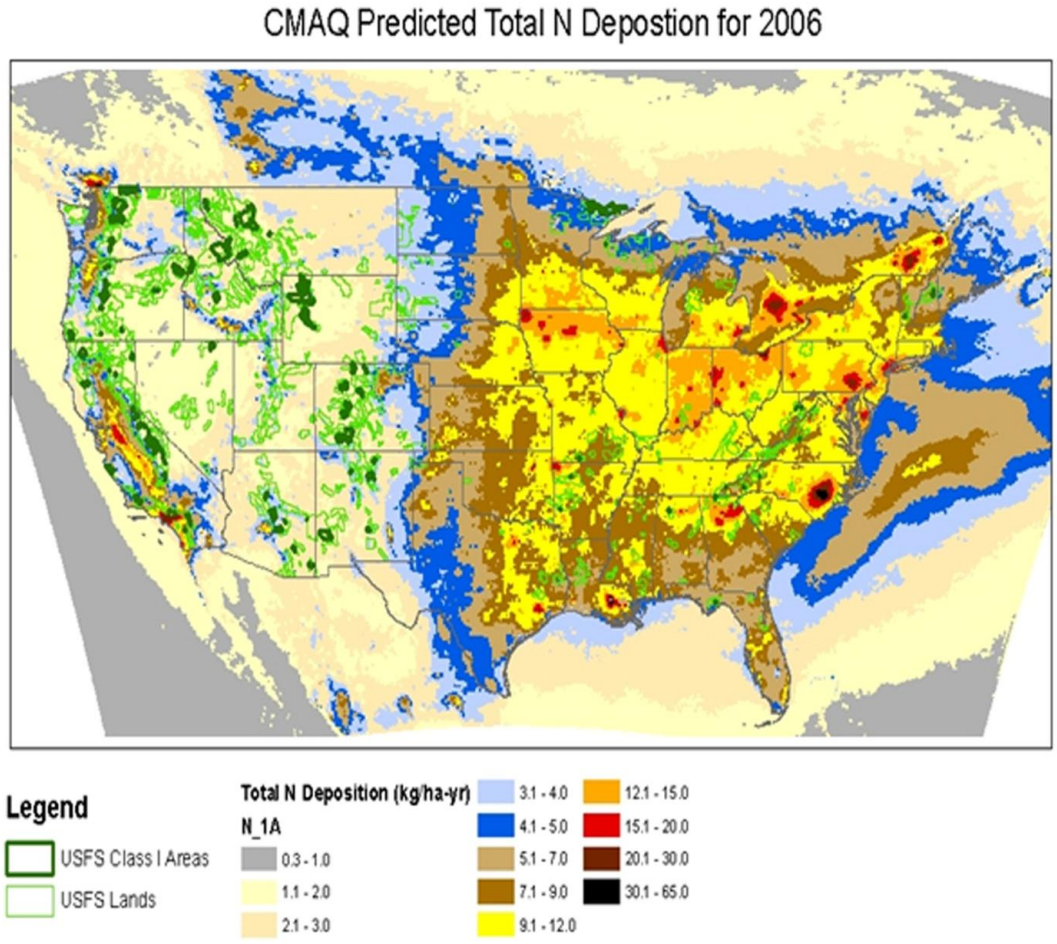
USDA Forest Service Lands, Wilderness, Class I Wilderness



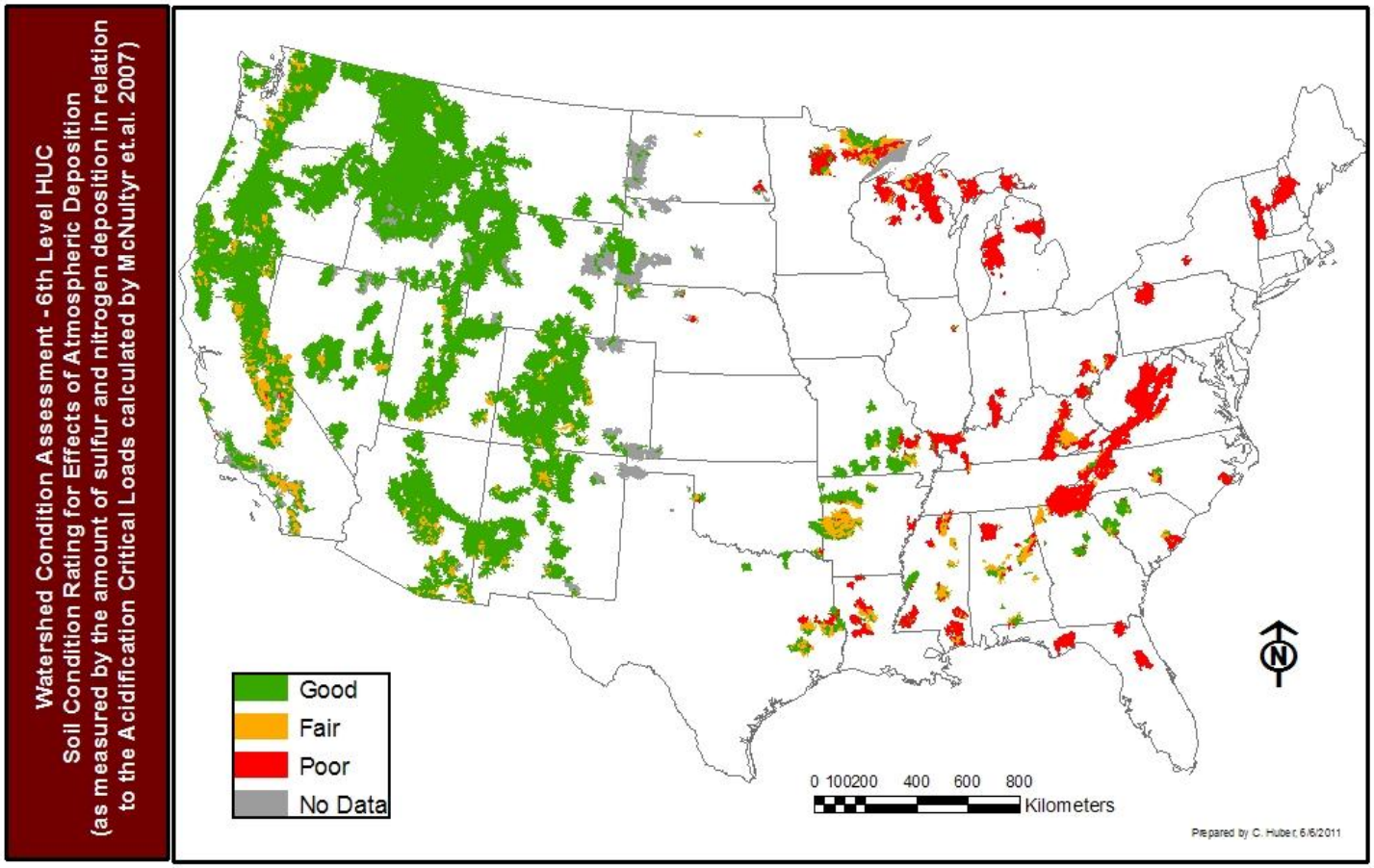
The USDA Forest Service manages 193 million acres, of which 36 million acres is designated wilderness and of that, 15 million acres (88 wilderness areas) is designated Class I wilderness per the Clean Air Act Amendments of 1977.



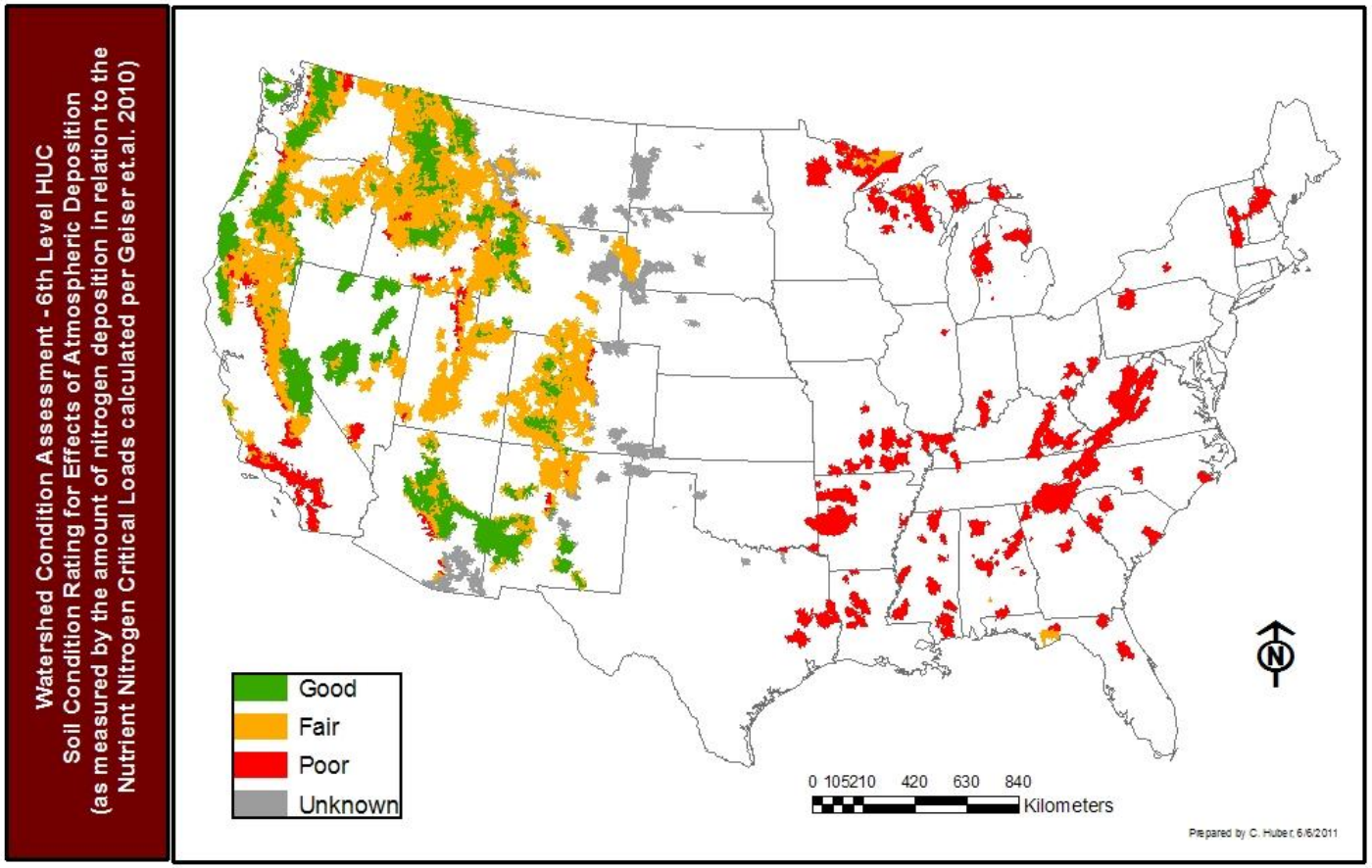
CMAQ Predicted Total S Deposition - This map shows the results of an air quality model run (CMAQ is Community Multiscale Air Quality). Sulfur deposition across the contiguous states is estimated from emissions data combined with meteorological data. Sulfur deposition can lead to acidification of surface water and soils. It is immediately apparent that sulfur deposition in the eastern half of the US is many times greater than in the western half. Forest Service Class I areas are shown as dark green polygons.



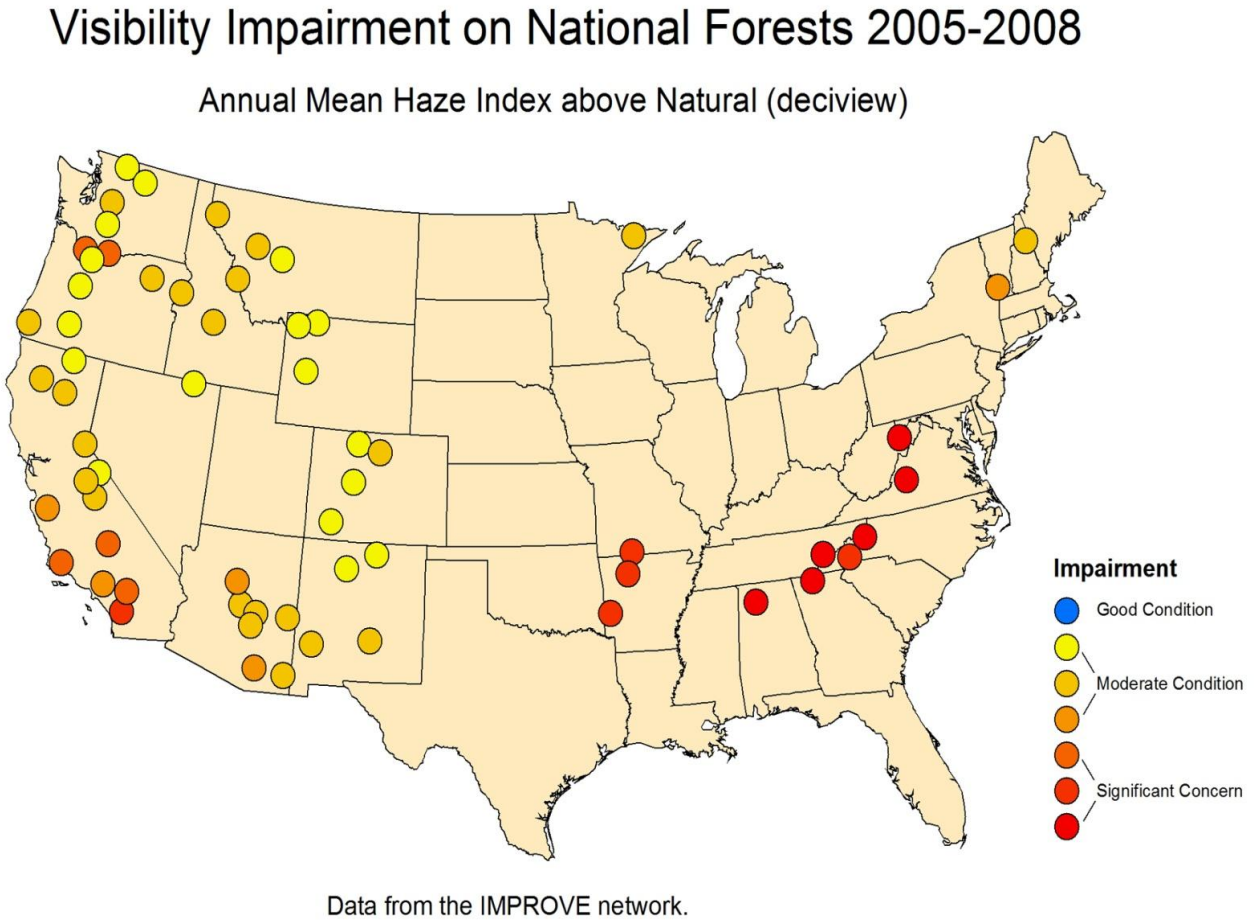
CMAQ Predicted Total N Deposition - This map shows the results of an air quality model run (CMAQ is Community Multiscale Air Quality). Nitrogen deposition across the contiguous states is estimated from emissions data combined with meteorological data. Nitrogen deposition can cause eutrophication of surface water and unwanted nitrification of soils. Generally nitrogen deposition is greatest near urban areas and agricultural activities. Forest Service Class I areas are shown as dark green polygons.


Watershed Condition Assessment - 6th Level HUC
Soil Condition Rating for Effects of Atmospheric Deposition
(as measured by the amount of sulfur and nitrogen deposition in relation to the Acidification Critical Loads calculated by McNultyr et.al. 2007)
Good
Fair
Poor
No Data
0 100200 400 600 800
Kilometers
N
Prepared by C. Huber 6/6/2011

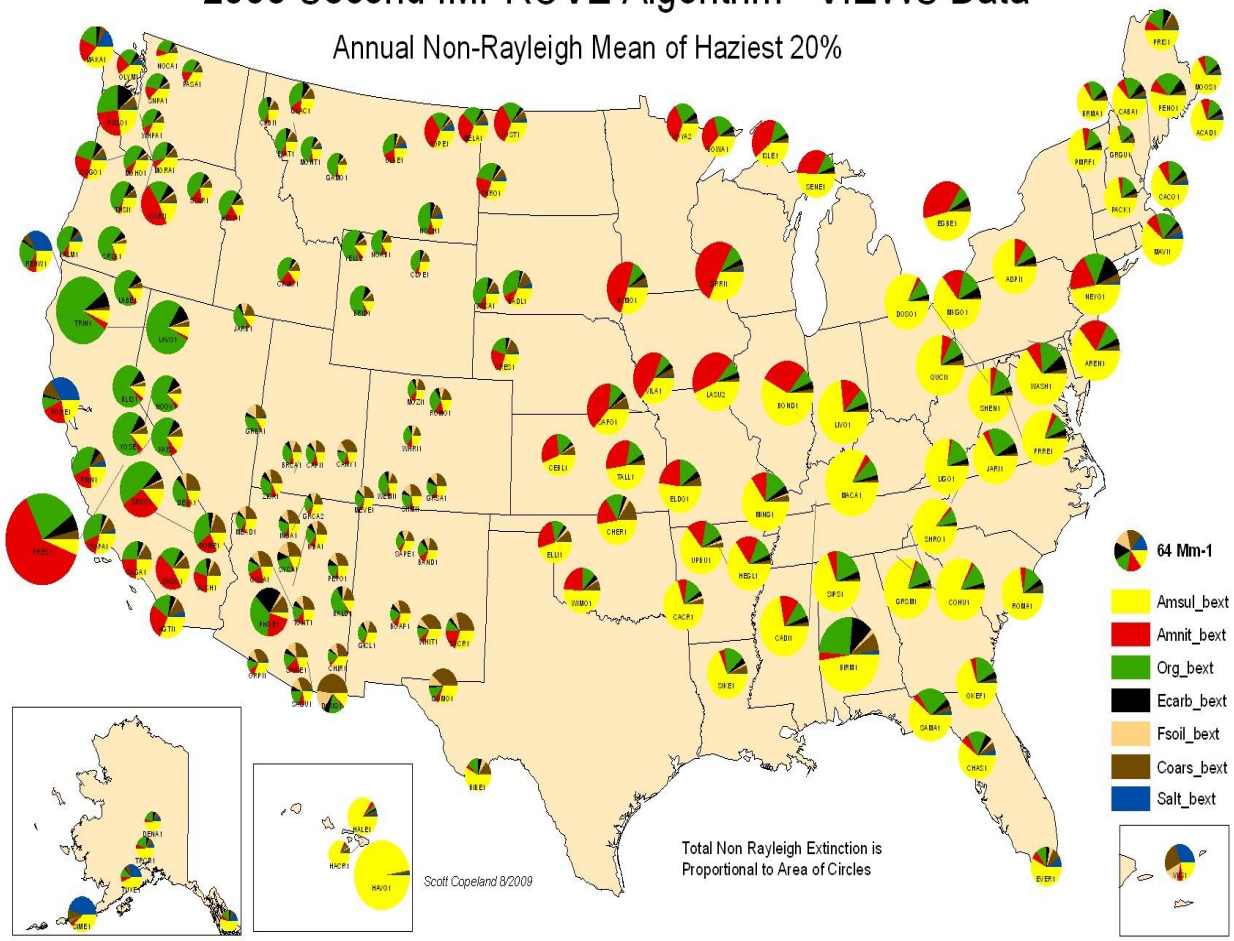
Acidity Critical Loads - The analysis used to generate these critical loads considers factors such as geology, vegetation, and modeled or measured deposition (McNulty et al. 2007). Several eastern National Forests are at least partially red on this map, indicating that portions of the forests are exceeding the critical load for acidity. The majority of Forest Service lands are in the "good" category, while a few areas of the west are in "fair" condition.


Watershed Condition Assessment - 6th Level HUC
Soil Condition Rating for Effects of Atmospheric Deposition
(as measured by the amount of nitrogen deposition in relation to the Nutrient Nitrogen Critical Loads calculated per Geiser et.al. 2010)
Good
Fair
Poor
Unknown
0 105210 420 630 840
Kilometers
N
Prepared by C. Huber, 6/6/2011

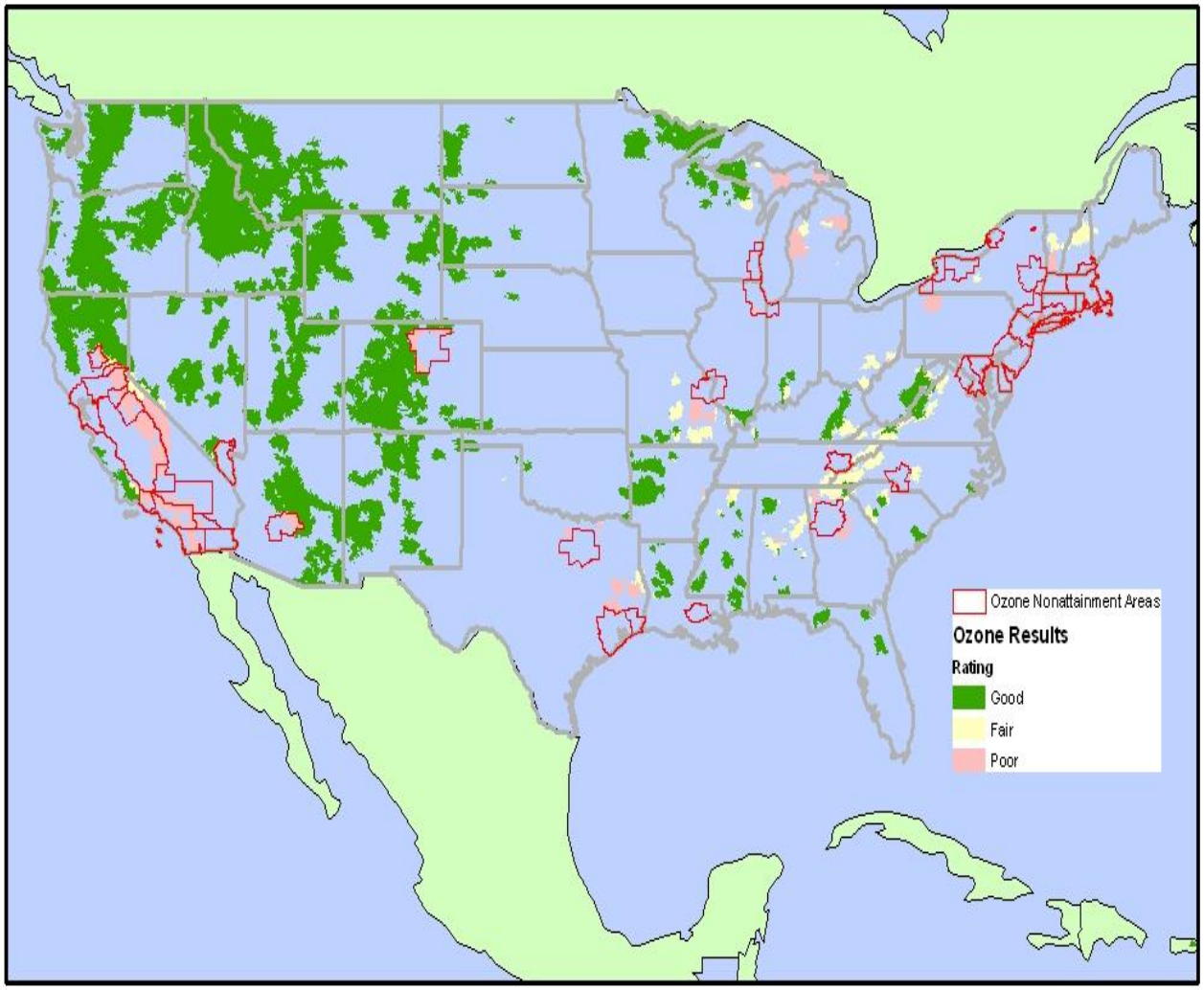
Nutrient N Critical Loads – The analysis used to generate these critical loads was based on the work of Geiser et al. (2010) focused on lichen data. Condition ratings were determined through comparison of N deposition to the calculated critical load for nutrient N.



Visibility is routinely measured near all Forest Service class I areas by the IMPROVE network. Data from the network were compared to estimates of natural (pre-industrial) conditions and a semi-quantitative metric assigned which represents the degree of measured impairment. The worst impairment is measured in the Appalachian and Ozark mountain regions and in Southern California. None of the contiguous 48 states' National Forests measured "good" visibility condition.



The IMPROVE visibility monitoring network measures the degree of visibility impairment at each location as well as the chemical composition of the aerosols which cause the impairment. Broadly across the Eastern US visibility is impaired primarily by sulfate aerosols, which result from combustion of coal for electrical generation. The Midwest tends to be more evenly split between nitrate and sulfate caused impairment, the nitrate linked to agricultural activities. The Western US is most impacted by organic matter, which is commonly attributed to smoke, except for Southern California which sees very high nitrate impairment, likely resulting from motor vehicle emissions.



Potential Ozone Impacts – High concentrations and exposures of ground-level ozone can impact both people's health, and sensitive vegetation. The areas outlined in red exceed national standards and people may have been impacted by ozone. National Forest watersheds were rated based upon the ozone exposures and a long-term soil moisture index that could impact black cherry (Region 9), tulip poplar (Region 8), and ponderosa pine (western US). Biomass reductions considered to be damage (poor rating) may have occurred to sensitive vegetation in California and some National Forests in Region 8 and 9.